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Article 4

1943

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Recommended Citation

McNutt, S. H. and Packer, R. A. (1943) "A Study of Some Cases of Streptococcus Infection in Swine," *Iowa State University Veterinarian*: Vol. 6 : Iss. 2 , Article 4.

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A Study of Some Cases of Streptococcus Infection in Swine

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THE following is a report of the study of a number of sick hogs from which streptococci were isolated, together with an attempt to evaluate the significance of such microorganisms in diseased swine tissues. The hogs examined were from scattered herds, largely under 8 weeks of age. In some instances nothing was known of the condition of the droves of hogs concerned, either before or after the examinations. In others there was a fairly good history of the condition of the herd and the death losses. In general the cases may be divided into those in which the streptococci were present throughout the body tissues and those in which the infection was confined to the brain and its coverings or largely so. To obtain an understanding of the disease condition encountered in the various herds, some description of individual cases is given.

Case History

Three pigs were received from the first herd studied. The death losses in the herd had been severe. The pigs were suffering from anemia, but because of marked nervous symptoms a laboratory examination seemed desirable. On examination advanced anemia was recognized but the only significant gross lesion indicating infection was a light colored opaque inflammatory exudate under the dura mater occurring in large patches in two individuals and rather uniformly covering the brain in the third pig. On closer examination this appeared to be a

purulent layer of some thickness and histological examination proved this to be true. Grossly the brain and the pia mater did not seem to be affected. Histological examination showed a moderate inflammation of the pia mater but marked evidence of encephalitis was encountered in only one of the three pigs. This inflammatory reaction consisted of perivascular and focal areas of infiltration in which polymorphonuclears were numerous. Cultures from these pigs showed enormous numbers of streptococci about the meninges and in the brain. Cultures from the lymph nodes, spleen, liver and kidneys showed no streptococcus colonies or only an occasional one. When this herd was placed on treatment for anemia, no more losses occurred.

In a second herd the pigs and sows were maintained in a permanent heated house with concrete unheated pens on the outside. The outside pens were little used because of cold wet weather. The animals were fed an adequate diet including sod, iron and copper, yet a very moderate anemia developed. It was thought that the anemia was not sufficient to account for the death losses. A number of pigs, less than 6 weeks old, suddenly developed convulsions and all such pigs died in less than 30 hours. Post-mortem examination of such animals revealed enormous numbers of streptococci whereas cultures from the lymph glands, liver, spleen and kidneys either remained free of bacterial growth or showed only an occasional streptococcus. Again histological examination of the various tissues from the pigs showed no significant lesions except for the brain

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and meninges, where very extensive inflammatory changes were encountered.

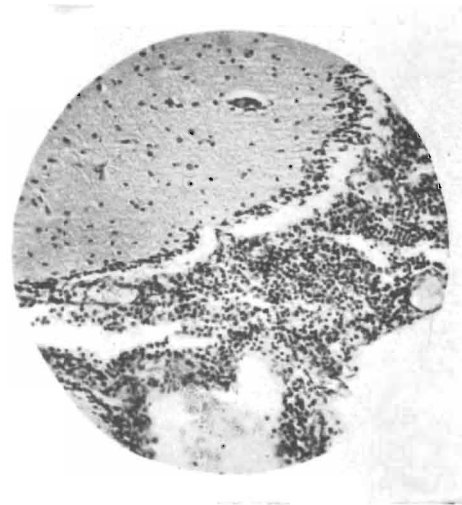
In a third instance, a herd of 85 pigs averaging about 90 pounds each was involved. Two pigs sickened suddenly and died in less than 36 hours. Within 6 days 4 more pigs sickened and of these 3 died and 1 recovered. Death occurred within 36 hours after symptoms were first noticed. No other losses occurred in this central nervous system involvement. Post-mortem examination showed only slight insignificant gross lesions. The tissues of these animals were cultured for bacteria with the result that streptococci were ground and suspended in physiological salt solution and injected into a wide variety of experimental animals including hogs, rabbits, guinea pigs, and chick embryos without demonstrating an infection other than the streptococci. Likewise histological study of the tissues showed evidence of streptococcus infection only. The major lesion was a very severe infiltration of the meninges. Polymorphonuclears were common among the infiltrating cells. It is worth mentioning that the streptococci were non-pathogenic for guinea pigs when injected intracerebrally but were pathogenic for pigs injected the same way with moderate numbers of the microorganisms. In the past, intracerebral inoculations of brain suspensions into guinea pigs has been employed in this laboratory for the isolation of bacteria from the brain of diseased animals. If it is found that the suis strains of streptococci are relatively non-pathogenic for guinea pigs, this may account for the scant number of cases of streptococcic meningo-encephalitis encountered in hogs in the past.

History Important

The 3 cases outlined above represent those in which an accurate history was available in each instance both before and after disease occurred. Aside from these, a number of pigs from isolated herds have been examined in which there was a severe meningitis or encephalitis caused by streptococci. Usually, in these cases 1 or 2 pigs were presented for diagnosis and no history was available at any time.

Except in 2 instances the pigs affected

with streptococcic meningo-encephalitis were less than 2 months old. One case of uncomplicated streptococcus meningo-encephalitis (the third above) was encountered on July 17, 1943, but aside from this all other cases occurred in the winter and early spring.



Section from the cerebellum of a pig, showing the greatly thickened, infiltrated, edematous meninges. Streptococcic meningitis associated with anemia. x 200.

A number of animals have been encountered in which streptococci occurred throughout the body, a generalized infection or septicemia. Perhaps the best example was furnished by a single herd from which 4 pigs were presented for examination and diagnosis. The pigs were known to have been sick for 1 or 2 days. All showed the same lesions on post-mortem examination, a moderate pneumonia, sero-fibrinous pericarditis and pleurisy with delicate strands of fibrin over the intestines or peritoneum. In the pericardial sac the fibrin was deposited in a moderately firm, adherent layer over the epicardium, streptococci were present in enormous numbers in the tissues of 2 of these 4 pigs, but especially in the sero-fibrinous exudates with only a few in the brain and meninges. Histological examination of the brains of these pigs showed no inflammatory reaction. Cultures from

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STREPTOCOCCUS

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the other 2 pigs showed no bacterial growth. Considering the lesions and symptoms, it was concluded that all 4 pigs were affected with an infectious disease, the causal agent of which did not grow on the usual artificial media and that the streptococci were opportunists that had gained entrance due to the lowered resistance of the pigs, such lowered resistance being due to the primary infection. An active agent was isolated from bacteria-free filtrates of sero-fibrinous exudates from the pigs. This has been tentatively identified as an influenza virus, possibly that of swine influenza, although it differs considerably from described strains of that virus. The disease found in these four pigs resembles the "filtrate disease" described by Shope.¹ It would appear that the conditions found in the pigs demonstrates that the streptococci in this instance were of little significance although on a superficial examination they appeared

to be the primary cause of the disease. Other cases of streptococcus septicemia have been encountered in other herds, but none in which the relationship between streptococci and other disease has been worked out so well as in the instance just cited.

Discussion

Detailed study of the streptococci isolated from the above cases showed little similarity among the various strains. Some of the strains were difficult to grow on ordinary culture media. In a few cases it was necessary to add 2 drops of sterile serum to the carbohydrate media in order to promote growth.

The morphology of these streptococci was quite variable. Some strains were very typical of the genus streptococcus, occurring as spherical cells in chains of 4 to 20 cells. Others showed little tendency toward chain formation in serum broth. Many of the cells were irregular in size and shape.

Studies of morphology were made from

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24 hour tryptose broth cultures. Hemolytic characteristics were determined from streak plates of 5 per cent blood agar. Media used to determine the biochemical reactions of the streptococci were prepared by adding 0.5 per cent of the desired carbohydrates and 1 per cent Andrade's indicator to tryptose broth. Sterilization was by autoclaving at 121° C. for 8 minutes. Sodium hippurate test medium was prepared by adding 1 per cent sodium hippurate to tryptose broth and autoclaving at 121° C. for 8 minutes. It was necessary to add two drops of serum to the carbohydrate media in order to promote growth of strains No. 6490 and Br. 83.

Biochemic Reactions

Table I shows the biochemical reactions of the various strains of streptococci isolated from the cases of meningitis studied. The group as a whole is quite heterogeneous as far as biochemical reactions are concerned. There is apparently no single species involved in this disease condition. None of the strains appear to belong to any of the recognized pathogenic species of streptococci. Whether or not these streptococci were secondary invading organisms is a matter of speculation.

It should be understood that the cases outlined above were selected instances in which streptococci were present in pure culture and in enormous numbers. No

instances are included in which mixed cultures of streptococci and other bacteria were obtained. It will be seen that the lesions and large numbers of streptococci in pure culture, that is, free of other bacteria, all very strongly suggest that the streptococci were the primary cause of the sickness in the pigs, yet, with but two exceptions, further study showed that there were other underlying causes. In these instances where a thorough study was possible it was shown that the primary cause of sickness was other than the streptococci. Anemia, even though very moderate, seemed to strongly predispose to streptococcus infection. It is known that many pigs show a slight anemia shortly after birth even though their care and feeding appear to be proper for its prevention. Perhaps this condition should not be designated "anemia" since anemia is usually associated with the abnormal. It might be better to consider this condition a slight diminution of the hemoglobin since it occurs so commonly that it could be within a normal range. It is also known that all anemic pigs do not die. A group of pigs may be rather severely affected with anemia and yet very few or none die, whereas in another group, which is not so badly anemic, there may be large losses. This has sometimes been one of the confusing features of pig anemia. Perhaps streptococcus infection has been

TABLE I

	Hemolysis	Lactose	Sucrose	Salicin	Mannite	Raffinose	Inulin	Trehalose	Solitol	Sodium Hippurate	Litmus Milk
Carey Pig	Weakly Beta	+	+	+	-	-	+	+	-	-	A sC pR
2169	Gamma	+	+	-	-	-	+	+	-	-	A sC pR
2180	Beta	+	+	-	-	-	-	+	-	+	A C pR
2191	Weakly Beta	+	+	+	-	+	+	+	-	-	A C pR
Br 83	Gamma	-	-	-	-	-	-	-	-	-	No change
2225	Weakly Beta	+	+	-	-	-	-	+	-	-	A C pR
6490	Gamma	+	-	+	-	+	+	+	-	-	A C
2299	Gamma	+	+	+	-	+	-	+	-	-	A sC
2298	Gamma	+	+	+	-	+	-	+	-	-	A sC
6B	Gamma	+	+	+	-	-	+	+	-	-	A
7B	Gamma	+	+	+	-	-	+	+	-	-	A

A = Acid
C = Coagulation
sC = Soft coagulation
pR = Partial reduction

one of the factors accounting for this condition. Undoubtedly streptococcus infection was the immediate cause of death in many of our anemic pigs. On the other hand, the pigs would not have succumbed to streptococci if they had not been anemic and thus more than normally susceptible to infection. It has been shown that the active agent, which is tentatively identified as an influenza virus, can kill baby pigs without the aid of bacteria. When associated with this agent, the streptococci are either secondary invaders or they behave like *Hemophilus influenzae suis* as shown by Lewis and Shope,² or like Pasteurella as demonstrated by Scott³, when in association with swine influenza virus. With one exception, all the cases of streptococcic meningo-encephalitis occurred in the winter and early spring. It is thought that these infections are not necessarily seasonal but rather that the pigs are most apt to suffer from a lowered resistance at these times of year making them more susceptible to streptococcic infection. The one exception mentioned above occurred in the summer. No evidence of other infection or lowered resistance from any cause could be demonstrated in this instance.

Conclusion

1. A streptococcic meningo-encephalitis of swine is described which is usually associated with lowered resistance.
2. A study of the cultures of streptococci isolated from cases of meningo-encephalitis shows that no individual species is involved but rather that several species may be associated with this condition.
3. None of the strains appear to belong to any of the recognized pathogenic species of streptococci.

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The current graduating class subscribed 100 per cent to *The Veterinary Student*.

ANTHRAX

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tissue are often seen as in prolapse of the rectum. An acute swelling of the spleen with a tensed capsule and a "raspberry" pulp consistency is one of the most diagnostic lesions. Other common lesions found on post-mortem are degenerated kidneys, hemorrhagic enteritis, edematous lungs, and liver degeneration. The blood is thick and tarry and shows decreased ability to clot.

In swine one observes a marked gelatinous, blood stained infiltration of the peri-pharyngeal connective tissue which may extend to the neck and thorax. The inflammatory swelling extends to the peri-laryngeal connective tissue and also to the laryngeal upper cervical lymph glands.

Mistaken diagnosis of anthrax is most often due to the enzootic nature of the disease. Peracute anthrax, however, may be

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